Letters to the Editor will be published, if suitable, as space permits. They should not exceed 1000 words (typed double-spaced) in length and may be subject to editing or abridgment.

Blood Pressure Threshold for Abnormal Ocular Fundus Findings Is Lower Than Expected

To the Editor:
Ocular fundus examination is a critical part of the physical examination in patients with severely elevated blood pressure (BP), which is defined by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) as a BP exceeding 180/120 mm Hg.1 Indeed, the presence or absence of severe, grade III/IV hypertensive retinopathy helps differentiate hypertensive emergencies requiring intensive care from less severe hypertensive urgencies.2 As a secondary analysis in the Fundus Photography versus Ophthalmoscopy Trial Outcomes in the Emergency Department (FOTO-ED) study,2,3 we sought to explore potential risk factors, in particular BP, for the presence of ocular fundus abnormalities relevant to the care of emergency department (ED) patients. We found evidence of acute end-organ ocular damage at lower blood pressures than the JNC7 criteria.

Three hundred fifty adult patients presenting to the Emory University ED with a chief complaint of headache, acute focal neurological deficit, visual changes, or a diastolic BP (DBP) ≥120 were prospectively enrolled during the FOTO-ED study (ClinicalTrials.gov NCT00873613) from March 2009 and January 2010. Photographs of the ocular fundus (optic disc and macula) were obtained from both eyes, using a commercially available nonmydriatic ocular fundus camera (Kowa α-D, Torrence, CA) by nurse practitioners on eligible patients between 7 AM and 10 PM, 7 days a week. Photographs were reviewed by neuro-ophthalmologists for ocular fundus abnormalities within 24 hours. Presenting complaints, triage systolic blood pressure (SBP) and DBP (ie, on arrival to the ED), heart rate, body mass index (BMI), age, race, and sex were recorded and evaluated as risk factors for ocular fundus abnormalities. Univariate and logistic regression analyses were performed.

Forty-four patients (13.6%) in the FOTO-ED study had ocular fundus abnormalities relevant to ED care: 13 optic disc edema, 4 optic disk pallor, 4 retinal vascular occlusion, 13 isolated intraocular hemorrhages, and 10 grade III/IV hypertensive retinopathy.2,3 Exploratory univariate analyses using quintiles of SBP and DBP suggested that the risk of ocular fundus abnormalities increased markedly within the highest quintile of SBP (≥169 mm Hg, 23% abnormal versus 10%, P=0.004) and within the highest 2 quintiles of DBP (≥86 mm Hg, 19% versus 9%, P=0.005). To avoid collinearity, these criteria were combined, and only patients with both SBP ≥170 mm Hg and DBP ≥90 mm Hg were considered to have elevated BP. Obesity (BMI ≥30) increased the risk of abnormalities (18% versus 10%, P=0.049), as did a chief complaint of visual changes (23 versus 9%, P=0.0005). Heart rate, age, race, and sex were not associated with ocular fundus abnormalities.

When we controlled for obesity and visual complaints, the odds ratio of a ocular fundus abnormality among patients with both SBP ≥170 mm Hg and DBP ≥90 mm Hg was 4.2 (95% confidence interval, 1.87–9.43), compared with those with a lower BP. Excluding the 21 of 350 (6%) patients who were enrolled on the basis of a DBP ≥120, this odds ratio was still significant: 2.8 (95% confidence interval, 1.03–7.5, Table). Seventeen of the 68 patients with elevated BP (25%) had fundus abnormalities. Seven of the 17 (41%) with abnormalities were among patients enrolled for DBP ≥120 (all of whom met the JNC7 SBP criteria for hypertensive crisis/emergency). However, the remaining 10 patients (59%) with abnormalities had an elevated BP by the present study’s definition (SBP ≥170 and DBP ≥90) but did not meet the JNC7 criteria. The ocular fundus findings among these 10 patients were 5 isolated intraocular hemorrhages, 2 grade III/IV hypertensive retinopathies (with BP 193/98 and 178/105), 1 anterior ischemic optic neuropathy, 1 branch retinal artery occlusion, and 1 optic neuritis.

We found that elevated BP (SBP ≥170 mm Hg and DBP ≥90 mm Hg) and obesity are risk factors for abnormal ocular fundus findings among patients presenting to the ED with headache or focal neurological complaints. Notably, our BP threshold is substantially lower than that at which JNC7 proposes to examine patients for evidence of end organ damage suggestive of hypertensive emergency (ie, >180/120 mm Hg). Among our patients meeting this less stringent BP threshold, 90% of the ocular findings (all except optic neuritis) can be clinically associated with elevated BP. We were disturbed to find that there were even 2 cases of malignant hypertensive retinopathy among them. These data suggest that the BP threshold proposed by JNC7 for severely elevated BP is probably too high. Furthermore, examining the ocular fundus of patients with both SBP ≥170 mm Hg and DBP ≥90 mm Hg who also have headache or focal neurological complaints is particularly appropriate.

Future study is necessary to externally validate these proposed lower BP thresholds, determine the applicability of these lower BP thresholds to patients who otherwise have no classic indication for ocular funduscopic examination (eg, no headache or focal neurological complaint), and determine the relevance of the ocular fundus abnormalities seen in patients with elevated BP to long-term outcomes.

Table. Multivariate Logistic Model for Abnormal Ocular Fundus Findings in 329 Patients Presenting to the Emergency Department With Chief Complaint of Headache, Acute Focal Neurologic Deficit, or Acute Visual Changes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP ≥170 mm Hg and DBP ≥90 mm Hg</td>
<td>2.8</td>
<td>(1.03–7.5)</td>
<td>0.04</td>
</tr>
<tr>
<td>Obesity, BMI ≥30</td>
<td>2.3</td>
<td>(1.1–4.8)</td>
<td>0.03</td>
</tr>
<tr>
<td>Acute visual chief complaint</td>
<td>5.1</td>
<td>(2.4–10.9)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

SBP indicates systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index. Intercept: –3.2, Hosmer-Lemeshow test, P=0.88.
Sources of Funding
This study was supported in part by an unrestricted departmental grant (Department of Ophthalmology) from Research to Prevent Blindness, Inc, New York, and by NIH/NEI core grant P30-EY06360 (Department of Ophthalmology). B.B.B. received research support from the NIH/PHS (KL2-RR025009, UL1-RR025008), NIH/NEI (K23-EY019341), and the Knights Templar Eye Foundation and received the American Academy of Neurology Practice Research Fellowship. C.L. received research support from Institut Servier (Paris, France), Fondation Planiol (Varennes, France), and the Philippe Foundation, Inc (New York, NY). D.W.W. received research support from NIH/PHS (KL2-RR025009). V.B. received research support from NIH/PHS (UL1-RR025008). N.J.N. is a recipient of the Research to Prevent Blindness Lew R. Wasserman Merit Award.

Disclosures
No funder had any role in the design or conduction of the study; in the collection, management, analysis, or interpretation of the data; or in the preparation, review, or approval of the manuscript. No conflicting relationship exists for any author.

Beau B. Bruce
Department of Ophthalmology
Emory University
Atlanta, GA
Department of Neurology
Emory University
Atlanta, GA

Cédric Lamirel
Department of Ophthalmology
Emory University
Atlanta, GA

David W. Wright
Department of Emergency Medicine
Emory University
Atlanta, GA

Valérie Biousse
Department of Ophthalmology
Emory University
Atlanta, GA
Department of Neurology
Emory University
Atlanta, GA

Nancy J. Newman
Department of Ophthalmology
Emory University
Atlanta, GA
Department of Neurology
Emory University
Atlanta, GA
Department of Neurological Surgery
Emory University
Atlanta, GA

References
Blood Pressure Threshold for Abnormal Ocular Fundus Findings Is Lower Than Expected
Beau B. Bruce, Cédric Lamirel, David W. Wright, Valérie Bioussé and Nancy J. Newman

Hypertension. 2012;59:e8-e9; originally published online December 27, 2011; doi: 10.1161/HYPERTENSIONAHA.111.187781
Hypertension is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2011 American Heart Association, Inc. All rights reserved.
Print ISSN: 0194-911X. Online ISSN: 1524-4563

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://hyper.ahajournals.org/content/59/2/e8

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Hypertension can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Hypertension is online at:
http://hyper.ahajournals.org//subscriptions/